REPORT

ON

The Hayward Mine.

BY

AUG. J. BOWIE, Jr., M. E.

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1868.

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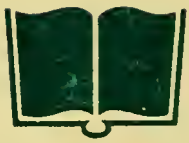

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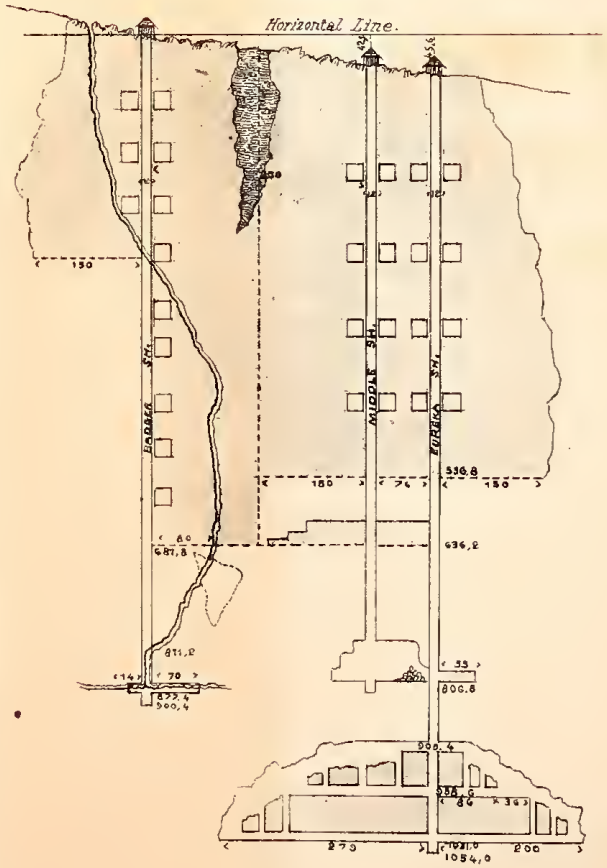

HAYWARD'S MINE.

FROM

COMPASS SURVEY

BY

A.J.BOWIE.JR.

1868.

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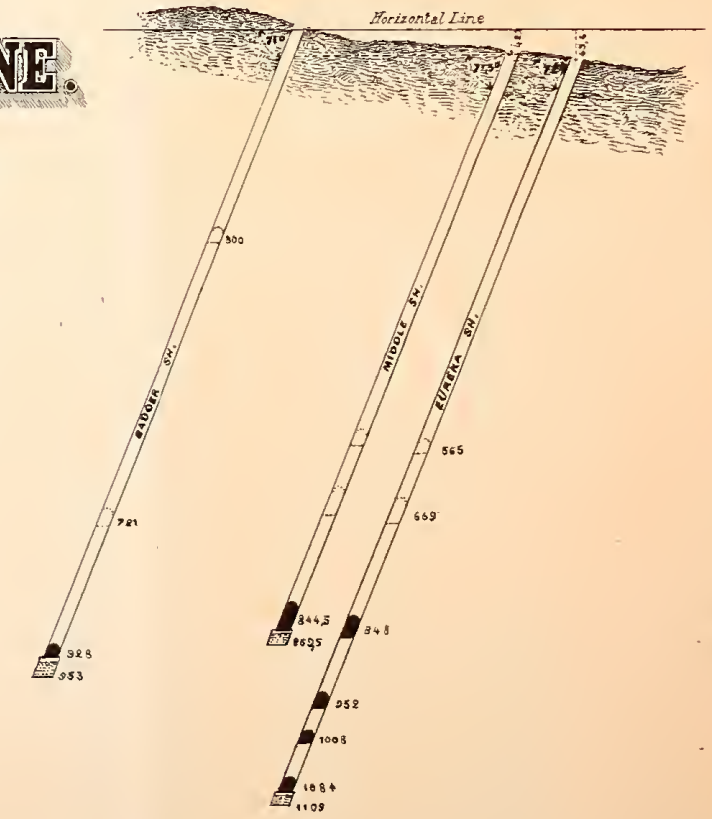

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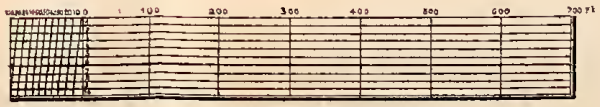
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San Francisco, February 29th, 1868.

Gentlemen:

Obedient to your instructions, I have made, and herewith submit, the following Report on the Hayward Mine.

Respectfully, etc.,

AUG. J. BOWIE, Jr.

To Hon. S. C. Hastings and

J. W. Gashwiler, Esq.

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REPORT.

AMADOR MINING COMPANY.

The property owned by this Company comprises Hayward's Mine, a forty-stamp and sixteen-stamp Mill, Blacksmith Shops, Coal Houses, a Powder Magazine, Lumber-Yard and Boarding-Houses—covering in all an area of about thirty-six acres. It is situated at Sutter Creek, Amador County, California, distant eighteen miles from Latrobe, a station on the line of the Sacramento Valley Railroad. Freight is transported from San Francisco at the following rates:

San Francisco to Sacramento.....	$ 2 00	per ton.
Sacramento to Latrobe.....	3 50	" "
Latrobe to Sutter Creek.....	12 00	" "

LOCATION, ETC.

The Mine was located in 1850, and staked out 1,850 feet on the ledge. In 1858, it was bought by Alvinza Hayward. In October, 1867, it was put on the stock market. There are 3,700 shares, at a par value of $400 per share.

AMADOR COUNTY.

This county lies between the Cosumnes and Mokelumne Rivers. Volcanic productions are developed along its southern side, and especially near Jackson. Auriferous slates, granite, trachite, lignite, and coal have been found. The auriferous belt runs through the center, and occupies a width of about twelve miles; its productive portions are chiefly on the northeast. To the northwest, between Jackson and Dry Town, there is a belt of quartz mines—the vein not continuous, but composed of a series of interrupted parallel belts. Quartz mining has been conducted in several places very successfully. Hayward's Mine lies on one of these belts on the hill to the east, and alongside the county road to Jackson.

MINE.

The mine has three shafts, called respectively: the *North*, *Middle* and *Badger*. The north shaft, or Eureka as it is commonly known, has been sunken on the ledge 1,109 feet six inches, with an average incline of 72 deg. Its size was originally seven feet by eight feet in the clear. Heavy 22-inch timber is used in keeping back the foot-wall. Throughout the entire length, the shaft is in good condition — saving an occasional post which has been crushed by the pressure of the wall. These, though replaced by side supports, have never been removed. At the

top of the shaft there is a horizontal engine 40-horse power; locomotive boilers three and a half feet in diameter, eighteen and a half feet long (builders, Goss & Lambert, Sacramento). The engine burns one and a half cords of wood in twenty-four hours; its original cost was $6,000. It is used for hoisting ore out of this shaft, the miners being also lowered and raised by it. The ore buckets are of iron, sufficiently large to contain a thousand pounds, and are suspended by short iron chains, attached to Manila cables seven inches in circumference. These cables run over small grooved iron wheels, which hang on iron hooks, fastened into a beam of the scaffolding erected over the shaft, and from thence are wound around the drum alongside the engine. The ropes on the drum are so arranged that when one bucket is lowering, the other is raising. The buckets slide on and between tracks made by small beams laid on the cross-timbers on the foot wall of the shaft. The beams are joined by iron plates. The work in this shaft has been prosecuted by a series of tunnels or levels running north and south on the vein, the intermediate spaces being worked out by stoping. From the 565-foot level running south seventy-six feet to the middle, and thence to the Badger, a distance of 300 feet, and in the opposite direction 150 feet to the north of the north shaft, the entire vein has been taken out to the surface, saving a few quartz pillars — left on the sides of the shafts as supports. This immense space, however, is

not open. The swelling of the foot-wall has been so great as to crush the huge timbers left as supports, and thus closing it entirely. At the end of the north level of the north shaft, the vein, when work was stopped, measured fifteen feet in width. From the 565-foot level to the 848-foot level, the vein on the north side of the shaft has been left undisturbed.

At the 848-foot level, a drift fifty-five feet has been run, and the ledge opened to eighteen feet. On the south side of the north shaft descending from the 565-foot level sixty-four feet, the ledge, except where crossed by the middle shaft, is untouched, running through 226 feet to the Badger line. Descending forty feet to the 669-foot level, the ledge, the same distance through, has been worked out. This level runs through to the Badger shaft. striking it at a depth of 721 feet. Though closed, it is sufficiently open to allow the water to drain from the Badger to the middle shaft, and serves as its drain to that depth. From the 669-foot to the 848-foot level the vein is solid. At the 848-foot level, a gallery on the south side leads to the middle shaft, at the head of the water sump. A dam has been constructed on the drift between these two shafts, so that in case of the overflow of the sump, the water would be kept out of the Eureka. The ledge on this side corresponds in thickness to that on the north side. From the middle shaft, thirty feet to the south, and north as far as the dam, it has been excavated forty feet in height.

From the 848-foot level to the 952-foot level, the ore on both sides is untouched. On the north side of this last-mentioned drift the vein near the shaft has been fully exposed, and measures twenty-two and a half feet. Thirty-eight feet from the shaft stopes connect it with the 1,008-foot level. In the stopes the vein has been opened seventeen and a half feet in width, leaving quartz on both sides. At the junction of the stopes at the 1,008-foot level, the ledge, eighty-six feet from the shaft, measures nineteen and a half feet. It has not been fully exposed, timber on hand not being sufficiently long to open it over twenty feet. From the end of the stopes of the 952-foot level, on the 1,008-foot level, the gallery has been worked thirty-six feet south. From here, stopes connect it with the 1,084-foot level. On the 952-foot level, south thirty-nine feet from the shaft, the ledge has been explored, and stopes connect it with the 1,008-foot level at a distance of 190 feet from the shaft. Descending now, by means of stopes, seventy-six feet six inches, the lowest level of the mine is reached (1,084 feet). Here, drifts have been run 200 feet north of the main shaft and 279 feet south of it. At the far end of the north level, the ledge has been opened sixteen feet. The last 100 feet of this level could not be seen, being filled with rocks from the stopes; as far as I could get in the stopes (140 feet), the vein ranged from seventeen to twenty feet. On the south side, the ledge, at the end of the level, measured three and a half feet.

At the bottom of this shaft is a sump twenty-five feet deep; here the ledge measures sixteen feet.

MIDDLE SHAFT.

The middle shaft is situated south seventy-six feet from the Eureka. The incline 71 deg. 30 min. It is used as a drain shaft for the mine. No work is at present prosecuted in it. It is well timbered and in good condition.

Twenty-seven barrels of water are hoisted hourly from this shaft. The barrels are made of iron, and hold 250 gallons. The hoisting apparatus is similar to that at the north shaft. There is a fine horizontal engine 96-horse, locomotive boilers four and a half feet in diameter, twenty-one feet long, in excellent condition. It consumes one and a quarter cords of wood per day. At the 851 1-2-foot level, corresponding with the 848-foot level of the north shaft, the two shafts have encroached one on the other eight feet. The sump in the middle shaft is twenty-five feet deep.

BADGER SHAFT.

The Badger shaft is situated 300 feet to the south of the middle shaft. It stands high on the hill. The size was originally seven feet by six feet in the clear, but in places is much larger. The incline is 71 deg. At the depth of 300 feet the main ledge crossed the shaft to the north; there the ledge known as the Boulder ledge first made its appearance, deriving its

name from the many boulders of gold-bearing quartz which were found in this mass of decomposed slate. Seventy feet from the bottom the main ledge entered this shaft and joined the Boulder ledge, the former being near the hanging wall, the latter next between it and the foot wall. From here on they have kept together. At the 928-foot level a drift has been run north seventy feet. The ledge measures three feet, and from all appearances looks as if it were going to widen out to the north. The ore found here is worth ninety-six dollars a ton. On the south side a level fourteen feet has been extended. The ledge is about two and a half feet, the foot wall pressing it more or less. The pressure exerted on the vein at this point has been very uneven, and leads me to suppose that for some distance it may alternate, pinching, then rounding out and perhaps in places pressed apart with masses of slate interposing. At the 721-foot level the drain runs through to the middle shaft. A little below this, after the ledge had been lost, a drift north eighty feet struck the main ledge.

On the south side of the shaft, from the 928-foot level to the 300-foot level, no work has been done. From the 300-foot level to the surface the ledge has been taken out. This shaft is well timbered and in good condition, though the ventilation is not as good as in the other shafts of the mine, the air being conducted from the 721-foot level to the 928-foot level in boxes. Eight men work in this shaft. A 40-horse engine, with locomotive boilers three and a half feet in

diameter and eighteen and a half feet long, does the hoisting. It consumes one and a half cords of wood per day. The engine is in good repair. Cable, hoisting apparatus, etc., same as at the Eureka. The excavated levels of this shaft have been closed up. A slight cave occurred at the surface some time ago between the Middle and Badger shafts, which served to pack the excavated space and strengthen the mine. South of the Badger very little quartz is to be seen. A heavy mass of slate, in the shape of a wedge, was found near the 721-foot level, one end of it being in the vein. On exploring it was found that the vein split, going above, below, and to the rear of it.

On the extreme south end of the claim a small shaft, now closed, sixty feet deep, was sunk, and pay rock found. The out-croppings extended south seventy-six feet from the Badger shaft, and to a point north beyond the Eureka, excepting a small space midway between the Middle and Badger shafts, which was filled with quartz finely pulverized, clay, and slate, all intermixed, extending twenty-five feet in width, and going to the depth of 200 feet. The wedge, and mass of quartz, etc., I did not see, this portion of the mine being closed.

ORE IN SIGHT.

From a careful estimate of the ore in this Mine, the vein ranging between three and eighteen feet in thickness, and valued at fourteen to twenty dollars per ton, I find the sum of one million seven hundred and forty-eight thousand three hundred and nineteen ($1,748,319) dollars in sight: deducting thirty per cent. for working, contingencies, etc., there remains one million two hundred and twenty-two thousand three hundred and sixty-two dollars net profit.

EUREKA MILL.

The Eureka Mill is situated on the south side of Sutter Creek. From the north shaft house a rail-track, with sufficient incline, enables the carmen to deliver the ore at the battery. There are forty stamps —500 pounds each—eighty-two to eighty-four drops per minute, crushing forty-seven tons per day. In the dry season they are driven by a double engine, (Reynold's cut-off attached) locomotive boilers four feet in diameter, twenty-four feet long, twelve inch cylinders, and two-foot stroke. It consumes eight cords of wood in twenty-four hours. In the wet season steam is not used, the machinery being impelled by a strong twelve-foot breast-wheel, twenty-two feet in diameter. During the summer, when enough water has been collected, the wheel and engine run the machinery conjointly. The Company have exclusive right to all the

waters of the Creek for sixteen miles above. A flume 1,000 feet long, five feet wide and three feet deep, constructed of one and a half and one and a quarter inch timber, conveys the water from the dam on to the breast-wheel. This flume, to a great extent, has been lately renewed. The amalgamation is in the battery. A shaking-table, twelve feet long, is connected with every ten stamps; from these all the pulverized ore, etc., run on to galvanized copper plates, arranged with intervening traps, over which it continues for the distance of a hundred feet. The tailings are then caught in a stationary box. The right to collect sulphurets from here on, is sold to the highest bidder. The loss of mercury averages seventy pounds per month. A Blacksmith Shop and Coal House are attached to the Mill. The following men are employed:

2 Feeders, at $50 and $60	$110
2 Rockbreakers, at $40	80
Blacksmith and Aid, at $60 and $40	100
2 Carmen, at $50	100
Total	$390

BADGER MILL.

The Badger Mill is situated about three-quarters of a mile down the Creek. It has sixteen stamps, 500 pounds each, dropping eighty-four times per minute, crushing eighteen tons per day. The machinery is impelled by an eight-foot breast-wheel, twenty feet in diameter, which is revolved by a stream of water conducted on to it by a flume 600 feet long, four feet wide, and three feet deep. Two men are employed at the Mill. The ore is brought here from the Mine by teams. The amalgamation process is similar to that at the Eureka. The loss of mercury averages thirty pounds per month. The Mill runs steadily from eight to nine months during the year; and as often after that as the supply of water will permit. Adjoining the Mill is a Blacksmith Shop. Both the Eureka and Badger clean up twice a month. The following accounts, taken from the Company's books, show the expenses of the Mine and Mills, and the receipts from October, 1867, to February 1st, 1868:

Dr.		Cr.	
Oct. Total Expenses	$14,123 04	Bullion	$37,982 50
Dividend, $6.00 per share	22,000 00	By Credit— Sulphurets, etc.	388 50
	$36,123 04		$38,371 00
			36,123 04
Balance			$2,247 96

Nov.	Total Expenses	$13,505 43		Bullion	$36,580 17
	Per Dividend, $6 per share	22,000 00		Sulphurets, etc.	480 80
		$35,505 43			$37,060 97
					35,505 43
	Balance				$1,555 54

Mine—

Dec.	Labor	$4,167 97		Bullion	$34,471 97
	Taxes	223 31		Credits	528 92
	General Expenses	1,369 48			
	Sundries	1,290 50	$7,051 26		$35,000 89

Eureka Mill—

Labor	$1,293 66		
Foundry Tax	1,180 31		
Sundries	614 53	3,088 50	

Badger Mill—

Labor	$231 37		
Foundry Tax, etc.	379 90		
Store, Gen'l Expenses	321 99	933 26	
		$11,073 12	
Per Dividend, $6.00 per share (3,700)		22,000 00	33,073 12
Balance			$1,927 77

Dr.				Cr.	
Mine—					
Jan. Labor	$4,328	69	Bullion	$42,286	42
Foundry, Merchandise, Lumber, etc.	1,092	57	Credits, etc.	734	61
Mercury, Rope, Groceries, etc.	1,368	63		$43,021	03
			$6,789 89		
Eureka Mill—					
Labor	$1,289	09			
Foundry	771	81			
Lumber	45	15			
Merchandise	577	02			
Expenses, etc.	962	87	3,645 94		
Badger Mill—					
Labor	$238	67			
Foundry	248	51			
Sundries	58	75			
Merchandise	273	25	819 18		
Per Dividend, $6 per Share			22,000 00		33,255 01
Balance					$9,766 02

ASSETS.

1867.	November 1	$21,669 28
	December 1	13,559 37
1868.	January 1	12,270 60
	February 1	9,325 40

The average cost of working a ton of ore, during the month of January last, was $5.76; for the entire year, however, the average is higher. Wood is $5 per cord, and Lumber $28 per thousand feet. Employees of the Mine and Mills are boarded at the expense of the Company.

GEOLOGICAL FEATURES, ETC.

The vein is quartz, grayish-white, interlaminated with seams of soft slate. The dip is 71 deg. 15 min. 7 sec. east; the strike north 22 deg. west. Nearly one per cent. sulphurets of iron are regularly diffused through the ore. About the depth of 200 feet in the middle, and 180 feet in the north shaft, the Boulder ledge made its appearance, and from that depth has continued side by side with the main ledge. The probabilities are that this ledge was originally one and the same vein; the breaking up being caused by internal convulsions, and its decomposition effected by chemical action. The hanging wall is an argillaceous schist or slate, with small streaks of quartz running through it. The foot wall is soft and friable, being of decomposed slate, and absorbs a large amount of moisture.

The walls between which a vein lies more or less exert a certain influence on the substances which fill their fissures. By their power of conducting heat, they cause crystallization upon their exposed surface, and, according to their temperature, aid deposit. The amount

of heat conducted depends on their specific density, which in turn depends on the porosity of the encompassing walls. Generally, denser bodies are better conductors than less compact ones. The smoothness or roughness of the exterior surface of the walls, to a certain degree, determines the porosity. There is no doubt that water circulated in the cracks or fissures, pure or impregnated with other substances, sometimes alone takes hold of the ingredients of the bordering rocks, and changes or partially dissolves them. This fact is demonstrated in the decomposition, or change, observed in encompassing walls. In this vein the deposit of silica has been greatly owing to chemical action. The unequal distribution of the precious metal throughout the vein, may be hypothetically and partially attributed to the positive and negative discharges of electric currents, which would produce in equal solutions unequal precipitates. These several conditions, either alone or combined, have exercised a great influence on the present state of the vein. Its regular and defined walls prognosticate favorably for its continuation. Cracks in argillaceous slate are generally even and regular. Moreover, it is a well-established fact that veins in semi-crystalline slate are for the most part of quartz, silica being readily taken up from silicious minerals by heated waters.

That veins continue to a great depth, has been established beyond doubt. This was shown in a work of great authority by Herr Von Beust, and accords with the opinion of the greatest mining engineers of the

day, including the late Von Humboldt. It was upon this fact that work in the Saxon mines was resumed, and the continuity of veins in those districts has ever since been evidenced by a continuous production of metal. All documents furnished by the annals of Mining prove that a vein which has continued three or four hundred metres (984 to 1282 feet), increasing or decreasing in wealth, will, in all probability, continue the same for as many succeeding ones.

As opinions on Mines are necessarily governed by analogy, from the various features indicated in the Hayward Mine a conclusion thus drawn will be most favorable.

SUGGESTED IMPROVEMENTS.

EUREKA MILL.

The wood-work around the stamps, and the blocks upon which they are placed, need renewing. A considerable amount of amalgam secreted in the crevices, joints, cracks, etc., would be found on tearing up the old blocks; and judging from the amount thus obtained at the last renewal of the blocks at the Badger Mill, $12,000 to $15,000 might be looked for here.

THE MINE.

I would call attention to the encroachment of the north and middle shafts, at the 848-foot level of the former. This should be remedied: though of no immediate importance, it will prove a great inconvenience and danger if the mine is worked to any great depth.

This can be obviated in the next sinking of the middle shaft, by carefully inclining it slightly to the south. I would recommend that the north shaft be sunken 100 feet on the ledge; that the 1,084-foot north level be pushed forward 200 feet from its present terminus; also, that the 952 and 848-foot north levels be driven in the same direction. If at that distance the ledge maintains its thickness—16 feet—let a vertical shaft be driven simultaneously from the different levels and the surface, so as to strike the ledge at the 952-foot level (on the incline), or 905 feet vertical. The ledge could then be worked by galleries at right angles to the shaft, at intermediate places. The natural drain of the mine being north, would be in this shaft. Pumps should be introduced, and the present antiquated system of baling make room for modern improvements. Cars should be substituted for buckets, iron rails for wooden beams, and Manila cables give way to wire ropes.

In the north shaft, a rope lasts eight months; in the middle, three months; in the Badger, four to five months. A coil of this cable sufficiently long for two shafts, costs from $1,400 to $1,500. By such substitutions as recommended, and the sinking of this vertical shaft, the cost of extracting ore will be greatly diminished, and more work done.

Estimated cost of Shaft, $8 per foot (1,200)	$9,600
Timbering, etc.	7,000
	$16,600

The mine requires a shaft as a means of exit in case of accident—from which no mine is secure. The safety of the miners demands that something should now be done; though at present nothing apparently need be apprehended, should a cave or choking up occur at or near the 848-foot level, there is no possible means of escape. The chances of accident increase daily with the working, and proportionately should every facility for escape be afforded. In conclusion, the sinking of the inclined shaft on the vein should always be from fifty to sixty feet ahead of the lowest level: thus a continued prospecting is established, and the expenses incurred fully guaranteed by ore in sight.

AUG. J. BOWIE, JR.,

Mining Engineer.